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ARC DIGITAL RASTER IMAGERY (ADRI) DEVELOPMEMT

Synectics Corporation

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Air Force Materiel Command
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This document gives a general overview of the software developed and is intended to provide the knowledge necessary to understand the capabilities and general operation. A full set of design and testing documents were produced. This document is not intended to be a stand-alone user's manual or maintenance manual.

The ADRI development system provides a baseline capability to exploit the ADRI product. It provides the ability to perform point positioning against ADRI, as well as the ability to create a compressed ADRI product. The point positioning capability can be performed utilizing either compressed or noncompressed ADRI. The ADRI data compression subsystem provides the capability to take a raw, noncompressed, ADRI product and compress it by a factor of approximately 18:1.

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1.0 OVERVIEW

This document gives a general overview of the software developed under the ARC Digital Raster Imagery Development effort. This document is intended to provide a user of this software with the knowledge necessary to understand the capabilities and general operation of the software. A full set of design and testing documents, including the documents listed below, were produced for this effort:

√ Software Requirements Specification
√ Interface Requirements Specification
√ Software Programmer's Manual
√ Computer Resources Integrated Support Document
√ Software User's Manual
√ Software Test Plan
√ Software Test Description

This document is not intended to be a standalone user's manual or maintenance manual. For design and use details beyond the scope of this document, the user is referred to the appropriate documents as listed above.

1.1 SYSTEM OVERVIEW

The ARC Digital Raster Imagery Development (ADRID) system provides a baseline capability to exploit the ARC Digital Raster Imagery (ADRI) product. The ADRID system provides the ability to perform point positioning against ADRI, as well as the ability to create a compressed ADRI product. The point positioning capability can be performed utilizing either compressed or non-compressed ADRI.

The ADRID system consists of two subsystems:

√ ADRI Exploitation
√ ADRI Data Compression

The ADRI Exploitation subsystem provides point positioning capabilities in three languages: C, Ada, and FORTRAN. Each of the three implementations of this software has the following capabilities:

√ Point Positioning
√ Visit Geographic Point
√ Visit File Point
√ Save Point
√ Magnify Image
√ Adjust Contrast
√ Restore Contrast
√ Decompress Compressed ADRI

The ADRI Data Compression subsystem provides the capability to take a raw, noncompressed, ADRI product and compress it by a factor of approximately 18:1. The compressed data is written to a compressed ADRI file that is similar in format to the standard ADRI product (see

Appendix B for details of the compressed format). The ADRI Data Compression subsystem contains four individual programs. Each of the programs must be executed in succession to produce a compressed and formatted ADRI product. The programs are:

- √ Train
- √ Encode
- √ Packager
- √ Compare

2.0 USE OF ADRI POINT POSITIONING SOFTWARE

2.1 SYSTEM INITIALIZATION FOR POINT POSITIONING SOFTWARE

The point positioning software, as delivered under the ADRID effort, is hosted on a Sun Sparc IPC processor, running under the SunOS 4.1.1 operating system. This software also requires that an X11 or X11/NEWS server be installed on the host system or be accessible from a network.

In order to utilize the adrix application, your workstation must be booted. Boot procedures vary from one system to another. The following instructions apply to the general case in which default procedures are followed in starting up a Sun workstation. For the details of booting your particular workstation you should contact your system or facility manager.

2.1.1 GENERAL SUN BOOT PROCEDURE

The following general procedures should be followed to boot your workstation. Additional instructions can be found in the Sun System Administrator's Guide, Sun Sparc User's Guide, and the Sun Sparc Installation Guide.

1) Power on all external devices, including the monitor, external hard disks, CD-ROM drives, tape drives, etc.

2) Power on the main system unit. Following power-on, the system will boot. During the boot phase several pages of diagnostics will appear. After several minutes a login prompt will appear, indicating that the system is ready for use. If the system fails to boot, check to make sure all devices are powered on. If no problem is found, contact your system or facility manager.

2.2 APPLICATION INITIALIZATION FOR POINT POSITIONING SOFTWARE

The following instructions detail the procedure of logging into the host workstation and initializing the adrix application. These instructions assume that the adrix software is installed on the host system, the user has a user ID and password on the host system, and has access to the adrix executables and ADRI data sets from his/her account.

To initialize the adrix application execute the following instructions (boldface indicates user inputs, and italics indicate inputs that will vary depending on specific circumstances):

1) Log in on the host system. On the delivery system this is accomplished by entering the following at the login prompt:

   sface_sun login: **adrid**
   password: ***password***

2) Following the entry of the user name (adrid) and the password, the login procedures will execute. At this point the X11/NEWS server should also start. If the window server does not start, or you are unsure whether the window server has started, contact your system or facility manager. The instructions in the remainder of this document assume that the window server starts at login, and that the user is running the Open Windows graphical user interface. Other graphical user interfaces will vary in their behavior.

3) When the command window appears, use the mouse to place the cursor in the command window, and click the left-hand button. The command line cursor in the command window will be highlighted, indicating that the command window is now active.

4) At this point you must decide which version of the adrix application to execute. As detailed in the design documentation for CSCI 1, there are three equivalent implementations of the adrix application. These three versions are written in C, Ada, and FORTRAN. To execute the desired version you must change to the appropriate directory. On the system used for testing and delivery this is accomplished with one of the following commands:

   √C version

   - sface_sun% **cd c/source/adrix**

   √ Ada version

   - sface_sun% **cd ada/source/adrix**

√ FORTRAN version

- sface_sun% **cd fortran/source/adrix**

5) After executing the cd command in step 4, you will be in the directory containing the appropriate executable. To run the adrix application enter the following command:

   sface_sun% **adrix** ***adri_path initial_latitude initial_longitude***

   In this command the adri_path is the path to the directory containing the transmittal header (.THF) file for the ADRI data set with which you wish to work. On the system used for delivery and testing this path would be "/files/adritest/noncomp_adri" if you wish to utilize noncompressed ADRI, or "/files/adritest/comp_adri" if you wish to utilize compressed ADRI data. The initial_latitude and initial_longitude arguments indicate the coordinates on which the data is to be centered on application startup. These coordinates are optional, and are expressed in decimal degrees.

6) After the above command is entered at the Unix command line, the adrix application will initialize, and the specified ADRI data set will be displayed. If the application fails to start, see Section 4 for an explanation of errors.

2.3 APPLICATION FEATURES

The adrix application gives the user the ability to perform a number of ADRI exploitation functions. These functions, and a brief description of each, are as follows:

√ Point Positioning - Allows the user to determine the latitude, longitude, and elevation of a point within the coverage of the ADRI data set. This function is selected by use of the mouse buttons.

√ Visit Geographic Point - Allows the user to specify a latitude and longitude, and recenter the image display on that point. This function is selected from a menu bar button at the top of the screen.

√ Visit File Point - Allows the user to select a previously saved latitude and longitude and recenter the image display on that point. The point is selected from a list of points previously saved using the SAVE POINT function. This function is selected from a menu bar button at the top of the screen.

√ Save Point - Allows the user to save the latitude and longitude of the current center point of the image display. This point can later be viewed through use of the VISIT FILE POINT function. This function is selected from a menu bar button at the top of the screen.

√ Magnify - Allows the user to magnify the center of the current full-resolution image display by a factor of 2X. This function can be called numerous successive times, with each call magnifying by 2X. The magnification limit is reached when the entire full-resolution display window consists of just four pixels. This function is selected from a menu bar button at the top of the screen.

√ Adjust Contrast - Allows the user to perform a clip and stretch contrast enhancement on both the overview and full-resolution image window simultaneously. This function is selected either by a menu bar button at the top of the screen, or by pressing the center mouse button when the cursor is within an image window.

√ Restore Contrast - Allows the user to restore image contrast to its default setting after the ADJUST CONTRAST function has been executed. This function is selected from a menu bar button at the top of the screen.

√ Exit - Allows the user to quit from the adrix application and return to the Unix command line. This function is selected from a menu bar button at the top of the screen.

The next section describes the use of each of these features.

2.4 USER INPUTS

This section describes the use of each of the ADRI exploitation functions described in Section 2.3. The instructions given in this section assume that the host workstation is booted, the user is logged in, and one of the three versions of the adrix application has been successfully initialized with proper ADRI and DTED data sets.

2.4.1 POINT POSITIONING

1) Use the mouse to place the cursor on the desired point within either the overview or full-resolution window.

2) With the cursor on the desired point, press the left-hand mouse button. A menu will appear below the cursor with the following options:

"SET CURRENT POINT HERE"
"RECENTER DISPLAY AND SET CURRENT POINT"

3) Use the mouse to place the cursor on the desired option, and press any of the mouse buttons to select the option.

If the SET CURRENT POINT HERE option was chosen, the latitude, longitude, and elevation of the point will be displayed in the geographic information window.

If the RECENTER DISPLAY AND SET CURRENT POINT option was chosen, the latitude, longitude, and elevation will be displayed in the geographic information window, and both the overview and full-resolution image windows will recenter on the selected point.

2.4.2 VISIT GEOGRAPHIC POINT

1) Use the mouse to place the cursor on the VISIT GEO POINT button on the menu bar at the top of the screen.

2) With the cursor on the menu button, press the right-hand mouse button to select the function. An input window will appear.

3) Use the keyboard to enter the desired latitude and longitude in the input window, then press return. The input window will disappear, and both the overview and full-resolution image windows will recenter on the coordinates that have been entered. The latitude, longitude, and elevation will be updated in the geographic information window.

2.4.3 VISIT FILE POINT

1) Use the mouse to place the cursor on the VISIT FILE POINT button on the menu bar at the top of the screen.

2) With the cursor located on the menu button, press the right-hand mouse button to select the function. A list of point names will appear below the menu button.

3) Locate the name of the point you wish to visit, and use the mouse to place the cursor on the desired name.

4) With the cursor on the name of the desired point, press the right-hand mouse button. The name list will disappear, and both the overview and full-resolution image windows will be recentered on the selected point. The latitude, longitude, and elevation will be updated in the geographic information window.

2.4.4 SAVE POINT

1) Use the POINT POSITIONING, VISIT FILE POINT, or VISIT GEOGRAPHIC POINT functions (as described above) to select a current point to be saved.

2) Use the mouse to place the cursor on the SAVE POINT button on the menu bar at the top of the screen.

3) With the cursor located on the menu button, press the right-hand mouse button to select the function. An input window will appear near the bottom of the screen.

4) Use the keyboard to enter a name for the current point in the input window, then hit return. The input window will disappear, and the latitude, longitude, elevation, and name of the point will be appended to the saved points file.

2.4.5 MAGNIFY

1) Use the POINT POSITIONING, VISIT FILE POINT, or VISIT GEOGRAPHIC POINT functions (as described above) to select a current point and recenter the overview and full-resolution windows on the point to be magnified.

2) Use the mouse to place the cursor on the MAGNIFY button on the menu bar at the top of the screen.

3) With the cursor on the menu button press the right-hand mouse button to select the function. The full-resolution image window will be magnified by a factor of 2X, centered on the center point of the full-resolution image window before magnification.

2.4.6 ADJUST CONTRAST

1) If an image pixel brightness histogram is not currently displayed in the bottom right-hand corner of your screen, do one of the following to bring up the histogram:

√ Use the mouse to place the cursor within one of the image display windows, and press the center mouse button. The image pixel brightness histogram will appear near the bottom right-hand corner of the screen.

√ Use the mouse to place the cursor on the ADJUST CONTRAST button on the menu bar at the top of the screen. With the cursor on the menu button, press the right-hand mouse button. The image pixel brightness histogram will appear near the bottom right-hand corner of the screen.

2) Use the mouse to place the cursor within the image pixel brightness histogram at the desired lower brightness value. With the cursor at this location press the left-hand mouse button. The low end of the histogram will be clipped to this brightness, and the contrast will be stretched and updated in both the overview and full-resolution image display windows.

3) Use the mouse to place the cursor within the image pixel brightness histogram at the desired upper brightness value. With the cursor at this location press the right-hand mouse button. The high end of the histogram will be clipped to this brightness, and the contrast will be stretched and updated in both the overview and full-resolution image display windows.

4.7 RESTORE CONTRAST

1) Use the mouse to place the cursor on the RESTORE CONTRAST button on the menu bar at the top of the screen.

2) With the cursor located on the menu button press the right-hand mouse button. The contrast in both the overview and full-resolution image windows will be restored to its setting before execution of any previous ADJUST CONTRAST operations.

4.8 EXIT

1) Use the mouse to place the cursor on the EXIT button on the menu bar at the top of the screen.

2) With the cursor located on the menu button press the right-hand mouse button. The application will terminate, and the user will be returned to the Unix command line.

0 USE OF THE ADRI DATA COMPRESSION SOFTWARE

3.1 SYSTEM INITIALIZATION FOR DATA COMPRESSION

All programs within the data compression subsystem were designed for the Unix operating system. Commands and procedures for working within Unix may be found in the documents which came with the host machine. General initializations procedures are outlined in Section 2.1.

Otherwise, the only initialization specific to this software is setting the environment variable ISO_PATH. ISO_PATH must be set to the directory containing the THF file of the ADRI data set to be compressed.

3.2 USER INPUTS

Three standalone programs must be run to execute this CSCI. These programs are Train, Encode, and Pkgr (Packager). Encode may be run multiple times in order to split a large image into several smaller runs. These programs and their user inputs are described below.

Additionally, there are two utility programs provided to aid in viewing the results of the compression. Compare gives a statistical analysis of the compression process for a given image and code book. Display allows compressed and noncompressed images to be viewed on an 8-bit console monitor. These programs and their user inputs are also described below.

3.2.1 TRAIN

Train accepts noncompressed ADRI as input, samples the data, performs LOT on the samples, and does the VQ build and DCTinv to prcduce a code book.

3.2.1.1 Command Line

```
train <fname>  [-s size]  [-p psize]  [-d dir]
```

<fname> is in the form of “ssccddnn.IMG” or “ssccddnn.OVR’. It specifies the ADRI image file, which is in ISO 8211 format, to be compressed.

size represents the dimension of the training set to extracted. It is best if this is a multiple of 4. The default is 512, which causes the equivalent of a 512 by 512 pixel portion of the image to be used for training.

psize represents the cluster or patch size of image samples: 1 means that an 8x8 pixel patch is processed on each access to the file; 2 means a 12x12 patch; n accesses an (n+1)*4 squared patch. The accepted range for psize is 1 through 31. The default value is 1.

dir represents the directory where the code book produced for this image is to be located. The default is the local directory ("./").

3.2.2 ENCODE

Encode accepts a noncompressed ADRI image file and its corresponding code book as input. It compresses the data using Lapped Orthogonal Transform (LOT), Vector Quantization (VQ), and Arithmetic Coding (AC) compression techniques. It produces a compressed data set as output. This typically runs in batch mode and can specify partial images to be compressed. This facilitates restarting the compression of very large images if some unforeseen interruption of the process should occur.

3.2.2.1 Command Line

```
encode <fname>  [-s s_tile]  [-n n_tiles  [-d dir]
```

<fname> is in the form of "ssccddnn.IMG" or "ssccddnn.OVR'. It specifies the ADRI image file, which is in ISO 8211 format, to be compressed.

s_tile is the starting tile number for this compression run. This may range from 1 through the total number of physical tiles in the image. The default is 1, i.e., the first tile of the image.

n_tiles represents the number of sequential physical tiles to extract and compress. If n_tiles is not specified, all remaining tiles (i.e., from the starting tile through the end) will be processed.

dir is the directory where the corresponding code book for the image is located. The default is the local directory ("./").

3.2.3 PKGR

The Pkgr program concatenates the output of the compression process into one file in the ISO 8211 format.

3.2.3.1 Command Line

```
pkgr <base>  [in_path  [out_path] ]
```

<base> is the name of the compressed image or overview file to be created. It must be in the form “ssccddnn.IMC” or “ssccddnn.OVC”. This base is used to internally generate the following names of input files which were produced by either Train or Encode.

ssccddnn.CDBK	code book file
ssccddnn.00001.tCDIX	index(es) to start of tiles
ssccddnn.00001.tCDSQ	compressed data stream(s)
ssccddnn.xxxxx.tCDIX	index(es) to start of tiles
ssccddnn.xxxxx.tCDSQ	compressed data stream(s)

where the value of “xxxxx” is determined by the number of tiles in the previous index and data sequence files, and where “t” is either “I” or “O” for an “IMC” or “OVC” file, respectively.

in_path is the optional input file path. The default is the local directory (“./”).

out_path is the optional output file path. If this is specified, then in_path must also be specified.

3.2.4 COMPARE

Compare accepts a noncompressed ADRI image file and its corresponding code book as input, and runs a statistical analysis on the original image, a compressed-decompressed image, and the difference image of the two. This typically runs in batch mode and can specify partial images (contiguous physical tiles) to be compared. See Appendix A for the statistics collected and the corresponding formulas.

3.2.4.1 Command Line

```
compare <fname>  [-s s_tile]  [-n n_tiles  [-d dir]
```

<fname> is in the form of “ssccddnn.IMG” or “ssccddnn.OVR’. It specifies the ADRI image file, which is in ISO 8211 format, to be compared.

s_tile is the starting tile number for this comparison run. This may range from 1 through the total number of physical tiles in the image. The default is 1, i.e., the first tile of the image.

n_tiles represents the number of sequential physical tiles to extract and compare. If n_tiles is not specified, all remaining tiles (i.e., from the starting tile through the end) will be processed.

dir is the directory where the corresponding code book for the image is located. The default is the local directory (“./”).

3.2.5 DISPLAY

Display extracts contiguous logical tiles of compressed ADRI, decompresses them, and displays them on the system console.

3.2.5.1 Command Line

```
display <fname> [-t col row] [-s scale] [-w width] [-h height]
```

<fname> is in the form of “sscddnn.*ext*” where *ext* must be “IMC”, “IMG”, “OVC”, or “OVR”. It specifies the ADRI image file (either compressed or not) to be displayed. The support data file (i.e., GEN file) for this image is also derived from this parameter.

col row represent the logical tile coordinates of the upper left tile to the display. The default is 0 0 (i.e., the upper left corner of the image).

scale is a pixel intensity multiplier. This is needed to brighten dark imagery. The default is 4.

width specifies the width of the displayed image in tiles. The default is 4.

height specifies the height of the displayed image in tiles. The default is 4.

3.3 OUTPUTS

This section describes the expected output for the three programs discussed above.

3.3.1 TRAIN

Train produces a code book file with a name of either “sscddnn.ICDBK” or “sscddnn.OCDBK,” for a detail image file or overview image file, respectively. Train also produces the mean square error of the code book after each LBG iteration and after convergence is printed to standard out.

3.3.2 ENCODE

Encode produces two files. The first is a compressed data stream file with a name of "ssccddnn.xxxxx.ICDSQ" or "ssccddnn.xxxxx.OCDSQ," for a detail or overview image file, respectively. Since the length of each encoded tile is not predefined due to the use of arithmetic coding, the offset to the start of each tile must also be provided. This information is given in the code index file, which has the same name as above except with an extension of either "ICDIX" or "OCDIX." For both files, the "xxxxx" is the file name and is the starting tile number contained in the files. Also, the input and output file sizes and compression statistics are printed to standard out.

3.3.3 PKGR

Pkgr produces a single file with an extension of either "IMC" or "OVC". It contains the compressed form of the ADRI image in ISO 8211 format.

3.3.4 COMPARE

Compare prints the imagery statistics to the standard output file.

3.3.5 DISPLAY

Display places the imagery in a SunView window.

4.0 ERROR MESSAGES

4.1 ERROR MESSAGES FOR POINT POSITIONING

All error messages output by the adrix application are self explanatory. The majority of error messages produced by the application are generated on application startup. Messages generated on application startup will cause application initialization to fail, and leave the user at the Unix command line.

The only error message produced during application execution occurs when the user attempts to use the point positioning function without a proper DTED data set installed on the system. An error message will be generated on the console indicating that the DTED files are not present. This error will not be visible to the user until exiting from the application. However, when the no DTED condition occurs, an elevation of zero will be displayed for all points selected while in the adrix application.

4.2 ERROR MESSAGES FOR DATA COMPRESSION

The error messages which may be produced by the programs discussed in Section 3.2, above, are described in this section.

The errors that may be produced fall into two categories:

- √ User input errors
- √ System environment errors

An error from the first category occurs when erroneous input is given to a program. Each program is designed to print a general usage statement when a syntactic error occurs on the command line, such as specifying an option which does not exist. A usage statement gives the command line expected with a brief explanation of the options and parameters available. When the syntax of the statement is correct but a problem exists with the value of one of the parameters, more detail concerning the problem is given. For example, a value may be out of range or a file may not exist. Generally, instructions for correcting such problems are included in the error message. If a file does not exist, check for common errors such as misspelling of file names, being in the wrong directory, etc.

All other errors, such as a memory allocation error, are beyond the scope of the user to fix. Such error messages should be recorded and given to the appropriate personnel.

APPENDIX A

1.0 SYSTEM ARCHITECTURE

The ADRI Exploitation test bed architecture is presented in Exhibit A-1. The test bed is the only segment being defined by this document, and will consist of the hardware and software for exploiting the ADRI product.

There are two Hardware Configuration Items (HWCIs) which are a SUN SPARCStation with a 16-inch color display, high capability hard disk subsystem, and high capacity cartridge tape subsystem; and a DEC MicroVAX-II with an 8-bit programmable display adapter, color display monitor, high capacity hard disk, 9-track tape drive, and an optical disk subsystem.

There are two Computer Software Configuration Items (CSCIs). The first CSCI is the ADRI exploitation capability. This item executes as an integrated package with all capabilities accessible through the use interface. The primary purpose of this CSCI is to perform precise monoscopic point positioning. This CSCI consists of three primary Computer Software Components (CSCs), each an equivalent implementation of the same application written in three different languages: C, Ada, and FORTRAN. Support capabilities which are identified as lower level CSCs are:

√ Point Positioning - This is the user selection of a point of interest and the display of that point's latitude, longitude, elevation, and linear and circular error estimates.

√ Visit Geographic Point - This allows a user to specify a point that becomes the center of the area of interest.

√ Visit File Point - This allows a user to retrieve a point that has been saved and make it the center of the area of interest.

√ Save Point - This allows a user to save a point with a unique identifier for later use.

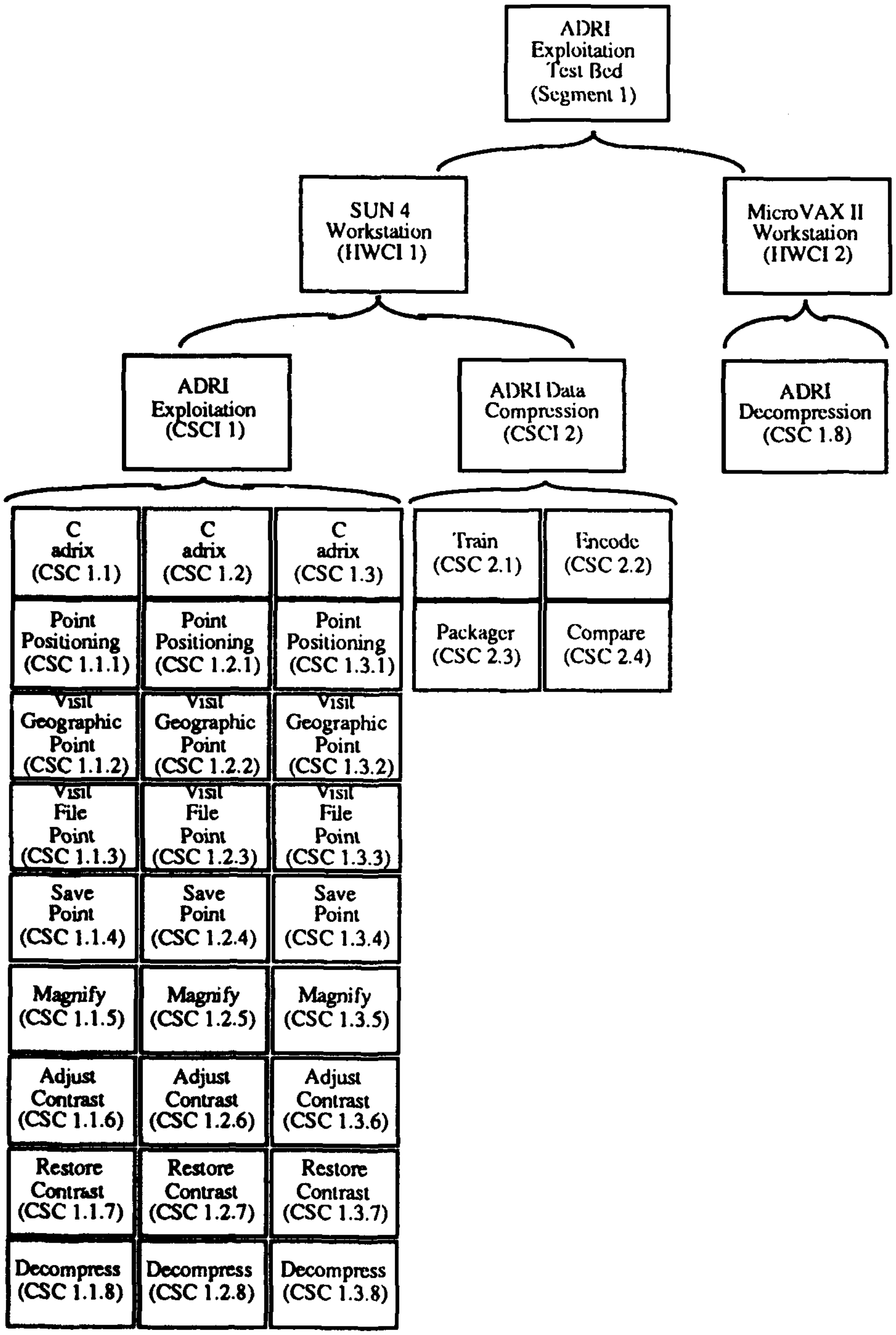
√ Magnify - This allows a user to zoom in or out on the displayed area of interest.

√ Adjust Contrast - This allows a user to adjust the contrast levels on a displayed image.

√ Restore Contrast - This allows a user to restore the original contrast levels on a displayed image.

√ Decompress - Converts compressed ADRI imagery into a format usable by the internal data structures of ADRI applications.

Exhibit A-1
System Architecture for the ADRI Exploitation Test Bed


ADRI Exploitation Test Bed (Segment 1)
SUN 4 Workstation (HWCI 1)
MicroVAX II Workstation (HWCI 2)
ADRI Exploitation (CSCI 1)
ADRI Data Compression (CSCI 2)
ADRI Decompression (CSC 1.8)
C adrix (CSC 1.1)
C adrix (CSC 1.2)
C adrix (CSC 1.3)
Train (CSC 2.1)
Encode (CSC 2.2)
Point Positioning (CSC 1.1.1)
Point Positioning (CSC 1.2.1)
Point Positioning (CSC 1.3.1)
Packager (CSC 2.3)
Compare (CSC 2.4)
Visit Geographic Point (CSC 1.1.2)
Visit Geographic Point (CSC 1.2.2)
Visit Geographic Point (CSC 1.3.2)
Visit File Point (CSC 1.1.3)
Visit File Point (CSC 1.2.3)
Visit File Point (CSC 1.3.3)
Save Point (CSC 1.1.4)
Save Point (CSC 1.2.4)
Save Point (CSC 1.3.4)
Magnify (CSC 1.1.5)
Magnify (CSC 1.2.5)
Magnify (CSC 1.3.5)
Adjust Contrast (CSC 1.1.6)
Adjust Contrast (CSC 1.2.6)
Adjust Contrast (CSC 1.3.6)
Restore Contrast (CSC 1.1.7)
Restore Contrast (CSC 1.2.7)
Restore Contrast (CSC 1.3.7)
Decompress (CSC 1.1.8)
Decompress (CSC 1.2.8)
Decompress (CSC 1.3.8)

The second CSCI is the Compression process for the ADRI product.

This CSCI will be executed as a standalone process. There are three components to the ADRI compression process. The CSCs for the compression CSCI are:

- √ Train - This is the generation of a code book for the vector quantization compression.
- √ Encode - This performs the retrieval of the code book and the arithmetic coding, lapped orthogonal transform, and vector quantization.
- √ Packager - This assembles the compressed overview and compressed image files and outputs the two as a single compressed ADRI product.

There is a fourth CSC, Compare, which is a post processing quality assurance step.

- √ Compare - This performs a statistical comparison of an image before and after compression.

1.1 OPERATIONAL SCENARIOS

There are two operational modes for the ADRI Exploitation test bed. The first operational mode is the Unix command line level which is the initial condition when starting the workstation. From the the command line the user may execute either of the two CSCIs. The ADRI exploitation CSCI is presented in Exhibit A-2. The second CSCI is the ADRI compression which is also executed from the Unix command line and is presented in Exhibit A-3.

Exhibit A-2
ADRI Exploitation CSCI Overview

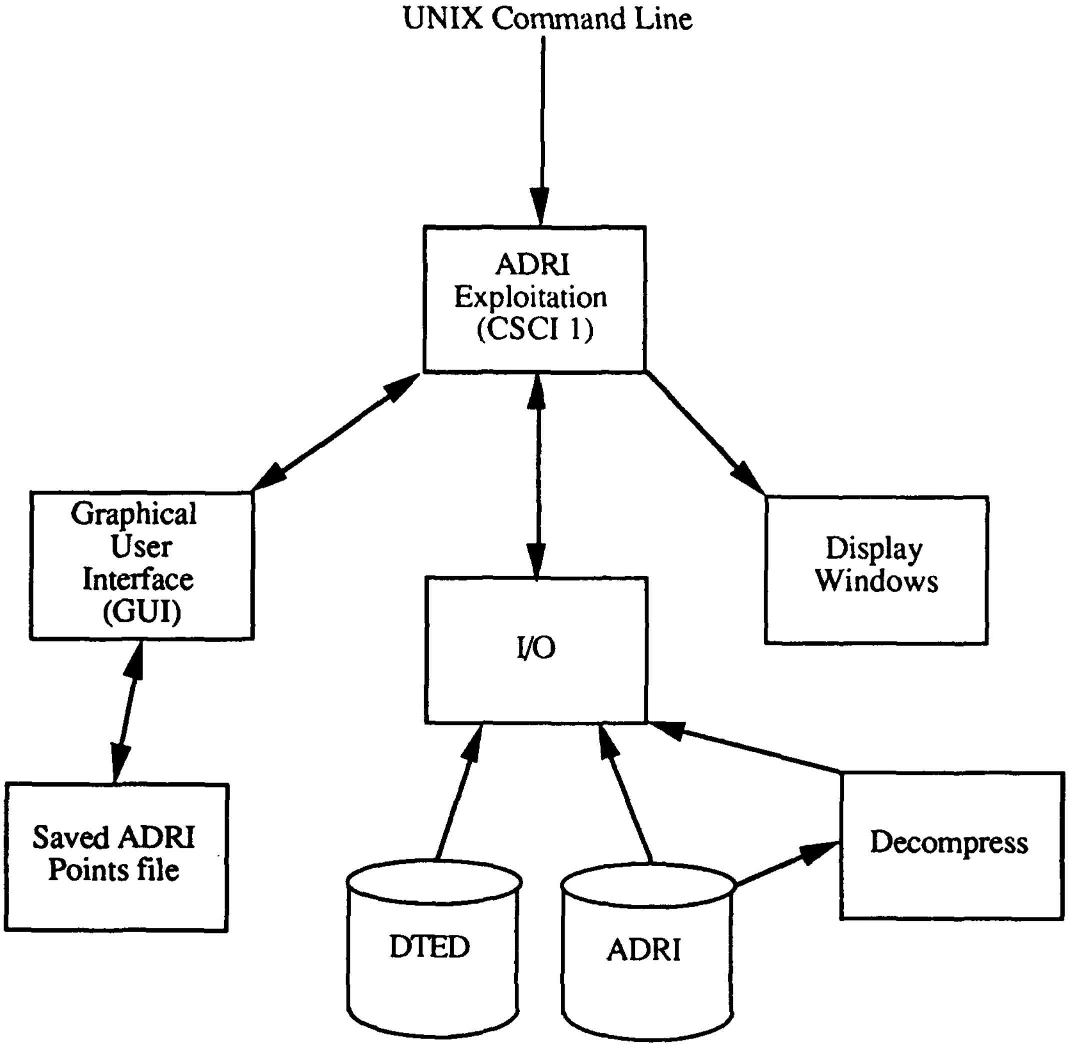
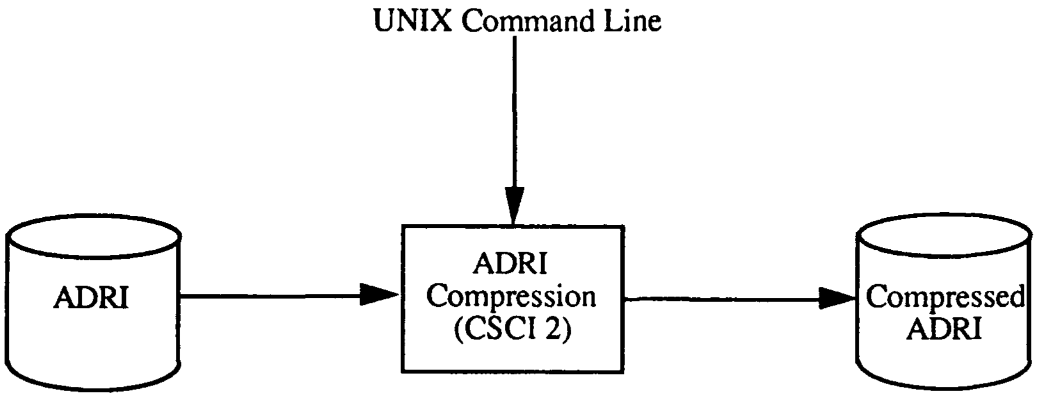


Exhibit A-3
ADRI Compression CSCI Overview



2.0 SYSTEM DESIGN

This section will present the system design for the ADRI Exploitation test bed. The design of the CSCIs will be presented at the CSC level.

2.1 HARDWARE (HWCI) IDENTIFICATION - SUN SPARCStation

The ADRI Exploitation software (CSCI 1) was developed on a SUN workstation in C, Ada, and FORTRAN. The operating system is UNIX and the graphical environment is X-Windows. The following list describes this HWCI.

√ Hardware

- SUN SPARC IPC
- 16-inch color display
- 8 MB RAM
- Internal floppy disk drive
- 207 MB internal hard disk
- 16 MB RAM upgrade
- External 8mm tape drive/669 MB hard disk
- External 644 MB CD-ROM drive

√ Software

- SUN OS with X-Windows
- Soft copy documentation
- SUN FORTRAN
- TeleSoft Ada

The software developed is designed to operate on any compatible configuration as a stand-alone system. The only external interfaces to the HWCI is the source data products on their respective media.

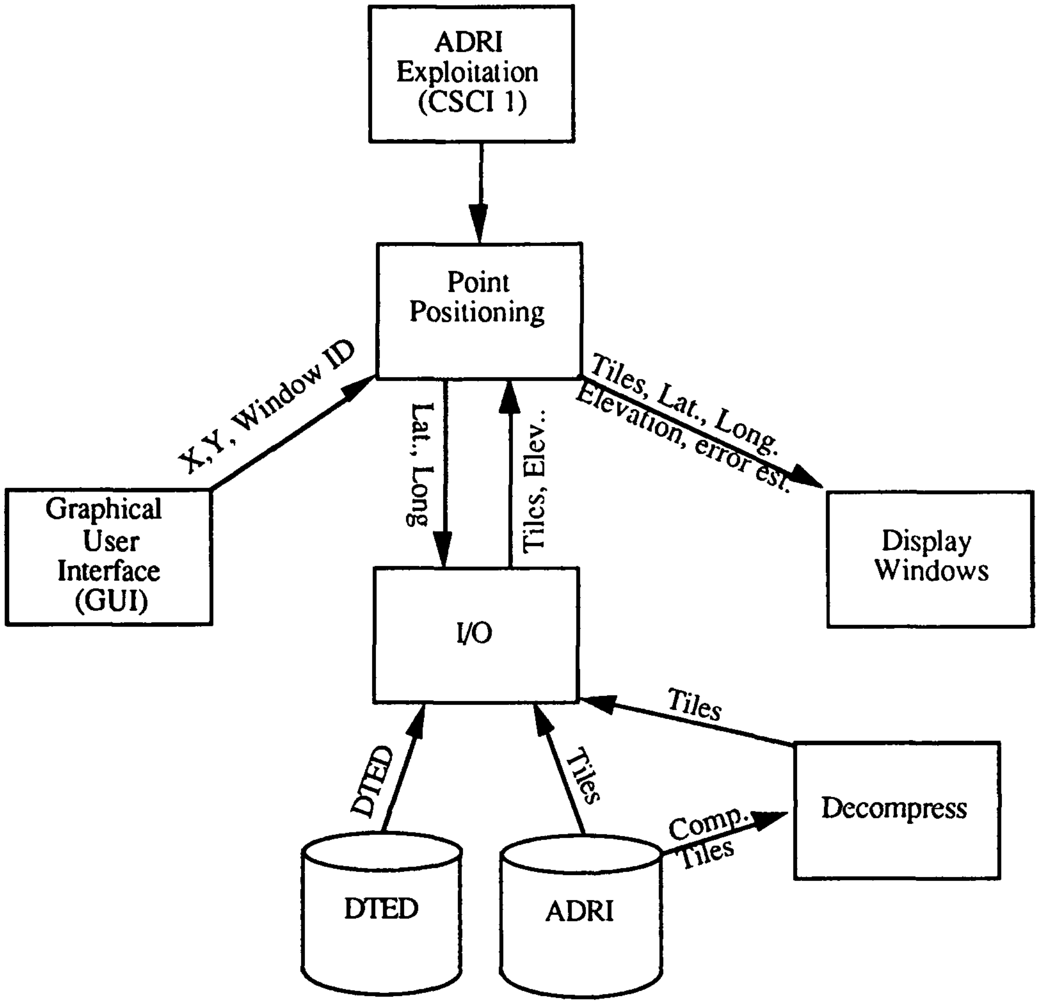
2.2 CSCI IDENTIFICATION

There are two CSCIs in the ADRI Exploitation test bed. One CSCI is the ADRI Exploitation item which is the self contained application of the ADRI product and Digital Terrain Elevation Data (DTED) to precise monoscopic point positioning. The other CSCI is a self-contained process that takes native ADRI data, compresses the ADRI data using arithmetic coding, lapped orthogonal transform, and vector quantization. Each of the two CSCIs are executable from the UNIX command line.

2.2.1 CSCI 1 - ADRI EXPLOITATION

The ADRI Exploitation CSCI performs the necessary processes for precise monoscopic point positioning using ADRI data and DTED. This CSCI satisfies all requirements contained within the Task Statement of Work, paragraph 4.1.2 and its subparagraphs. The design of the ADRI Exploitation CSCI is composed of 27 CSCs. The three top level CSCs (CSC 1.1, CSC 1.2, and CSC 1.3) are the top level ADRI Exploitation applications. The following exhibits present the lower-level ADRI Exploitation CSCs, their internal interface requirements, and manual operation requirements.

Exhibit A-4
Point Positioning, CSC 1.1.1, 1.2.1, 1.3.1



Manual Operation:

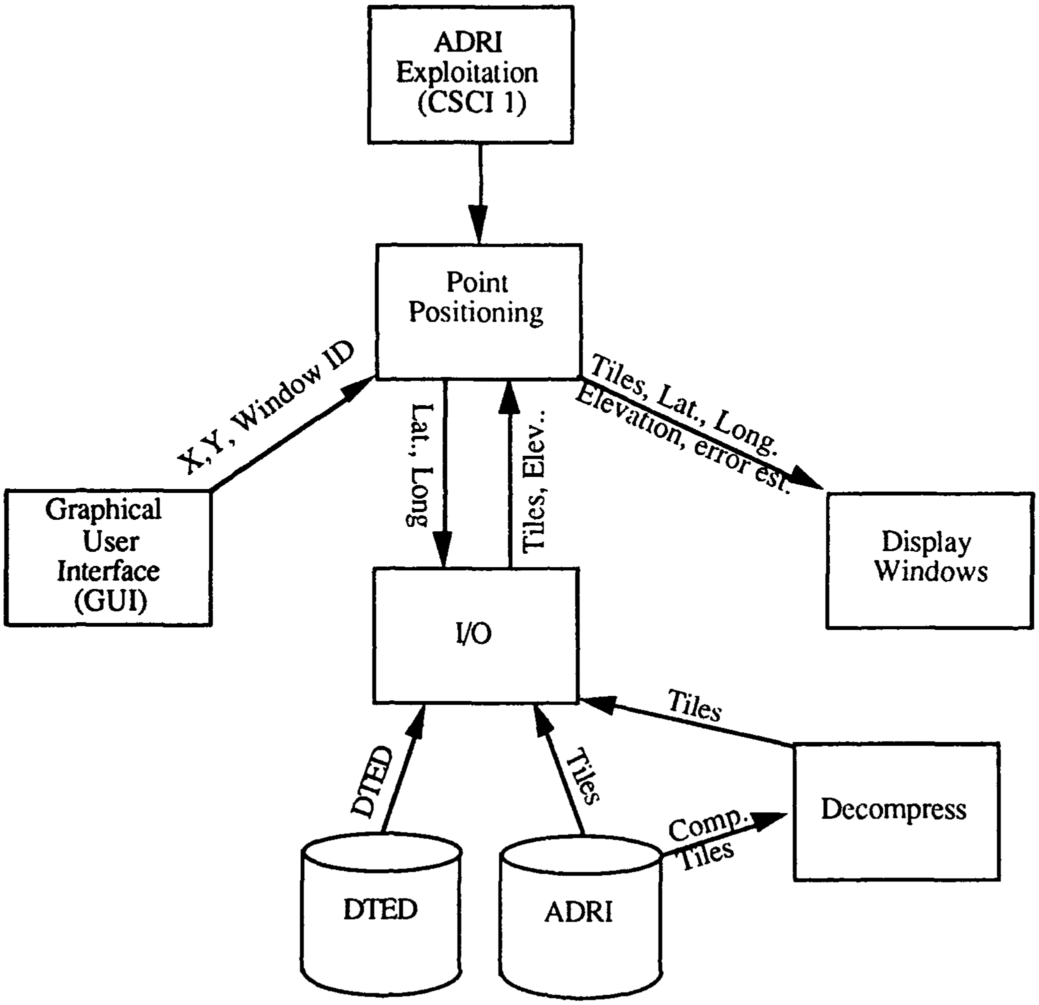
User selects point in either overview or full-resolution window by clicking left–hand or right–hand button of mouse.

Required tiles are calculated and input.

If left-hand mouse button was clicked, both windows are recentered on the selected point.

Latitude, longitude, elevation, and linear error/circular error estimates are displayed in the information window.

Exhibit A-5
Visit Geographic Point, CSC 1.1.2, 1.2.2, 1.3.2



Manual Operation:

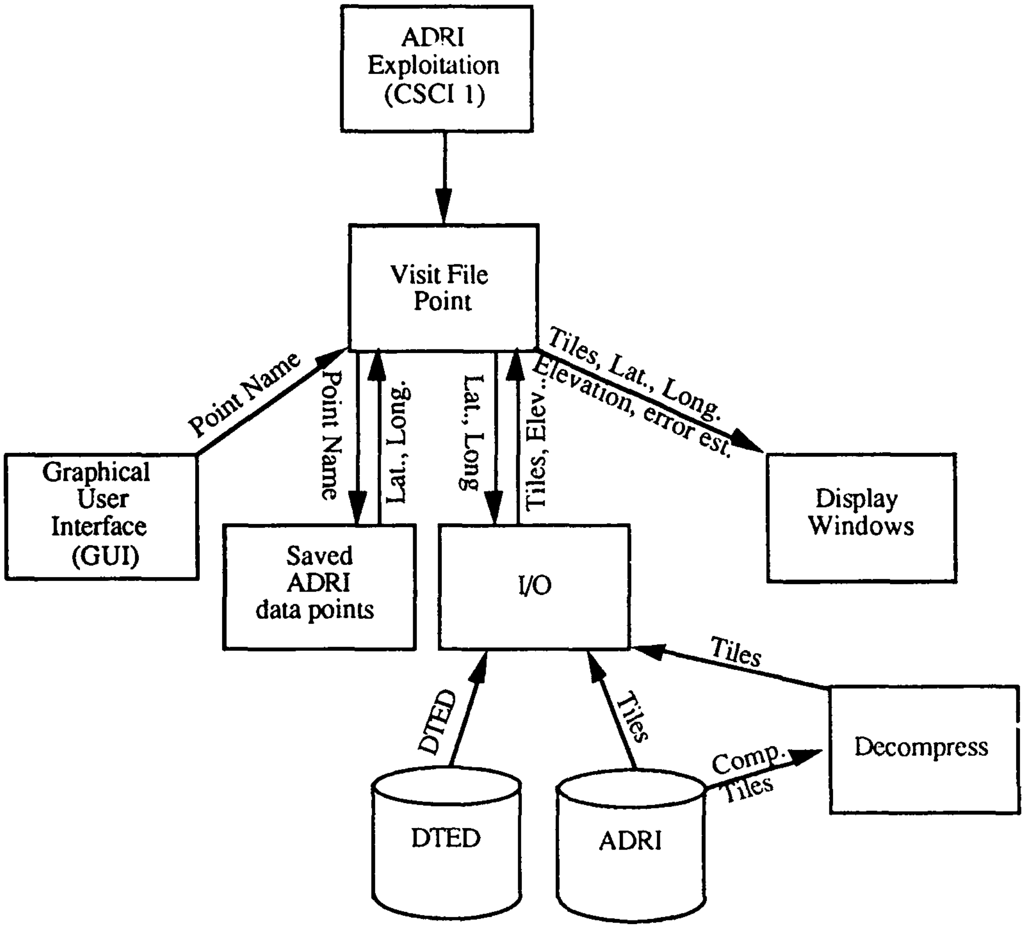
User selects point in either overview or full-resolution window by clicking left–hand or right–hand button of mouse.

Required tiles are calculated and input.

If left-hand mouse button was clicked, both windows are recentered on the selected point.

Latitude, longitude, elevation, and linear error/circular error estimates are displayed in the information window.

Exhibit A-6
Visit File Point, CSC 1.1.3, 1.2.3, 1.3.3



Manual Operation:

User selects from menu with right-hand mouse button.

A pull-down menu of point names appcars.

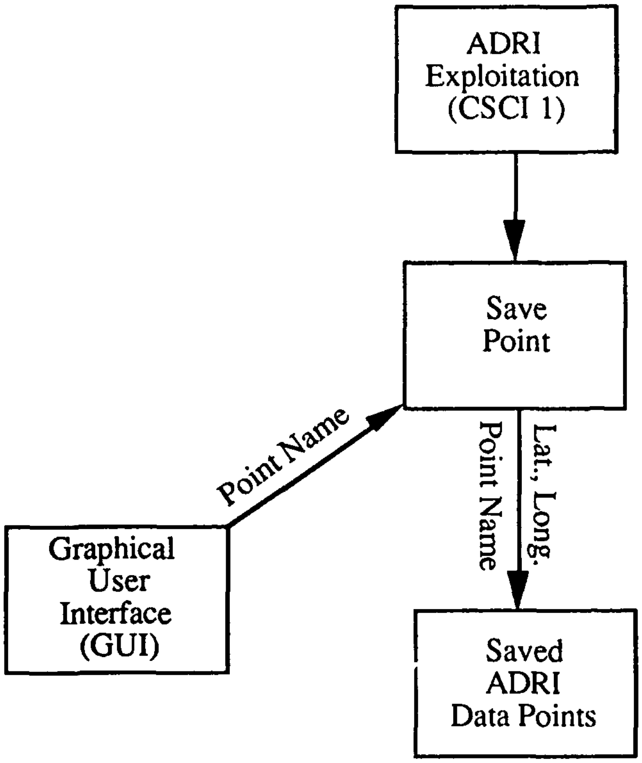
User selects one name by clicking with right-hand mouse button.

Required tiles are calculated and input.

Overview and full-resolution windows are recentered on the input coordinates.

Latitude, longitude, elevation, and linear error/circular error estimates are displayed in the information window.

Exhibit A-7
Save Point, CSC 1.1.4, 1.2.4, 1.3.4



Manual Operation:

User selects from menu with right-hand mouse button.

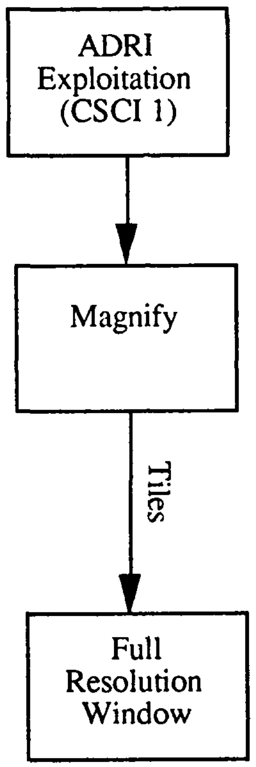
A text input window appears.

User enters name of save point and hits Enter.

Input window disappears.

Point name, latitude and longitude are written to end of file (ADRIPTS.DAT).

Exhibit A-8
Magnify, CSC 1.1.5, 1.2.5, 1.3.5



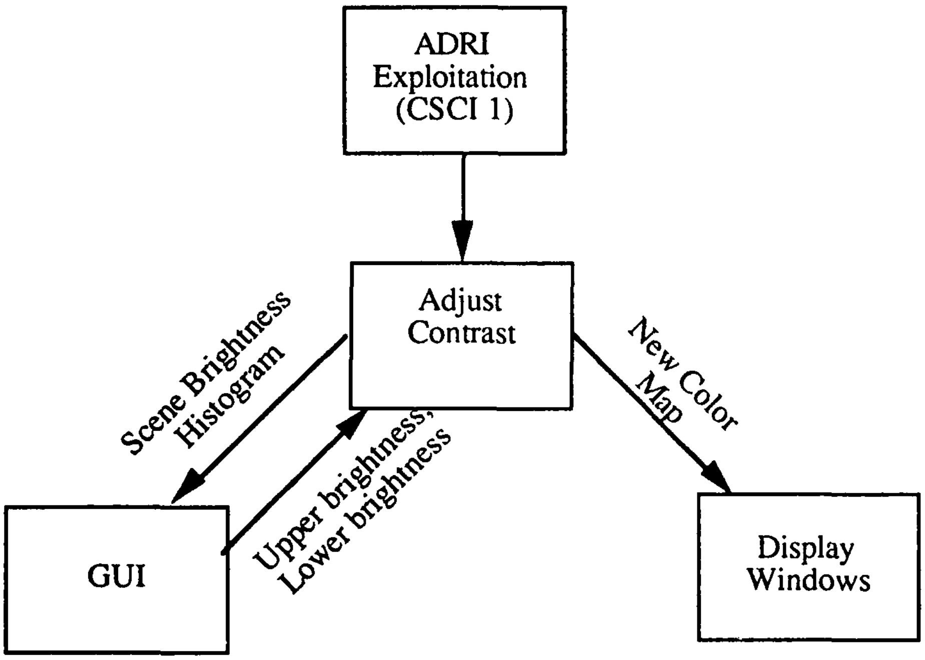
Manual Operation:

User selects from menu with right-hand mouse button.

Bitmap for full-resolution window is updated.

Full resolution is updated.

Exhibit A-9
Adjust Contrast, CSC 1.1.6, 1.2.6, 1.3.6


ADRI Exploitation (CSCI 1)
Adjust Contrast
Scene Brightness Histogram
Upper brightness, Lower brightness
New Color Map
GUI
Display Windows

Manual Operation:

User selects from menu with right-hand mouse button.

A scene brightness histogram appears.

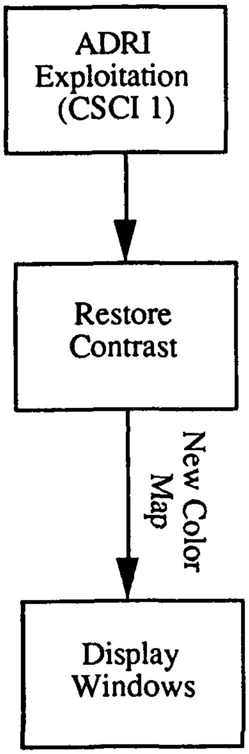
User clips upper end of histogram with right-hand mouse button.

User clips lower end of histogram with left-hand mouse button.

Center button removes histogram from display.

Contrast is stretched and display windows are updated.

Exhibit A-10
Restore Contrast, CSC 1.1.7, 1.2.7, 1.3.7



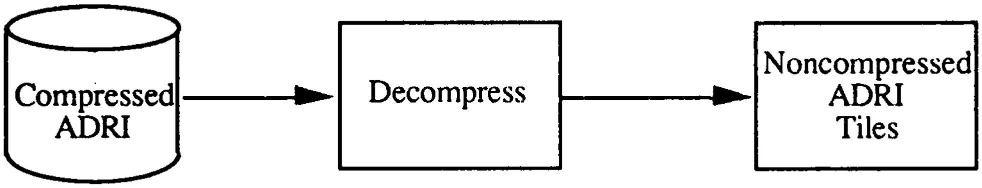
Manual Operation:

User selects from menu with right-hand mouse button.

Restore contrast to original levels.

Image display windows are updated.

Exhibit A-11
Decompress, CSC 1.1.8, 1.2.8, 1.3.8



Manual Operation:

None. All interfaces to this CSC are internal to the calling application.

2.2.2 CSCI 2 - ADRI DATA COMPRESSION

The ADRI Data Compression CSCI performs the necessary processes for compressing a native ADRI data file into a compressed ADRI . This CSCI satisfies all requirements contained within the Task Statement of Work, paragraph 4.1.3 and its subparagraphs. The design of the ADRI Data Compression CSCI is composed of four CSCs. The following exhibits, A-12 through A-15, present the ADRI Data Compression CSCs, their internal interface requirements and manual operation requirements.

2.2.2.1 CSC 2.1 - Train

See Exhibit A-12.

2.2.2.2 CSC 2.2 - Encode

See Exhibit A-13.

2.2.2.3 CSC 2.3 - Packager

See Exhibit A-14.

2.2.2.4 CSC 2.4 - Compare

See Exhibit A-15.

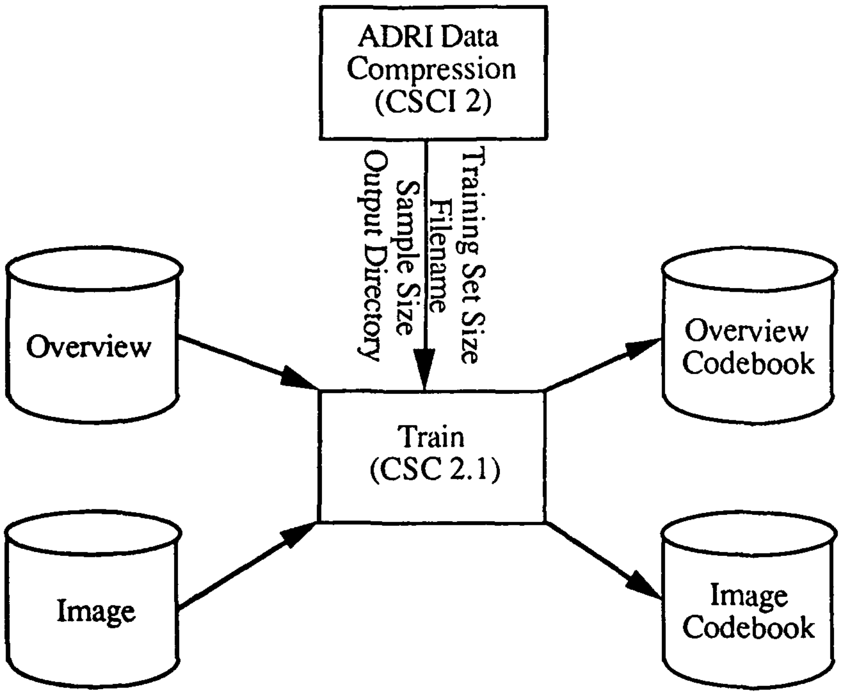
2.3 MANUAL OPERATIONS IDENTIFICATION

All manual operations associated with both CSCI 1 and CSCI 2 are identified in the following exhibits.

2.4 INTERNAL INTERFACES

All internal interfaces are identified in the following exhibits.

Exhibit A-12
Train, CSC 2.1

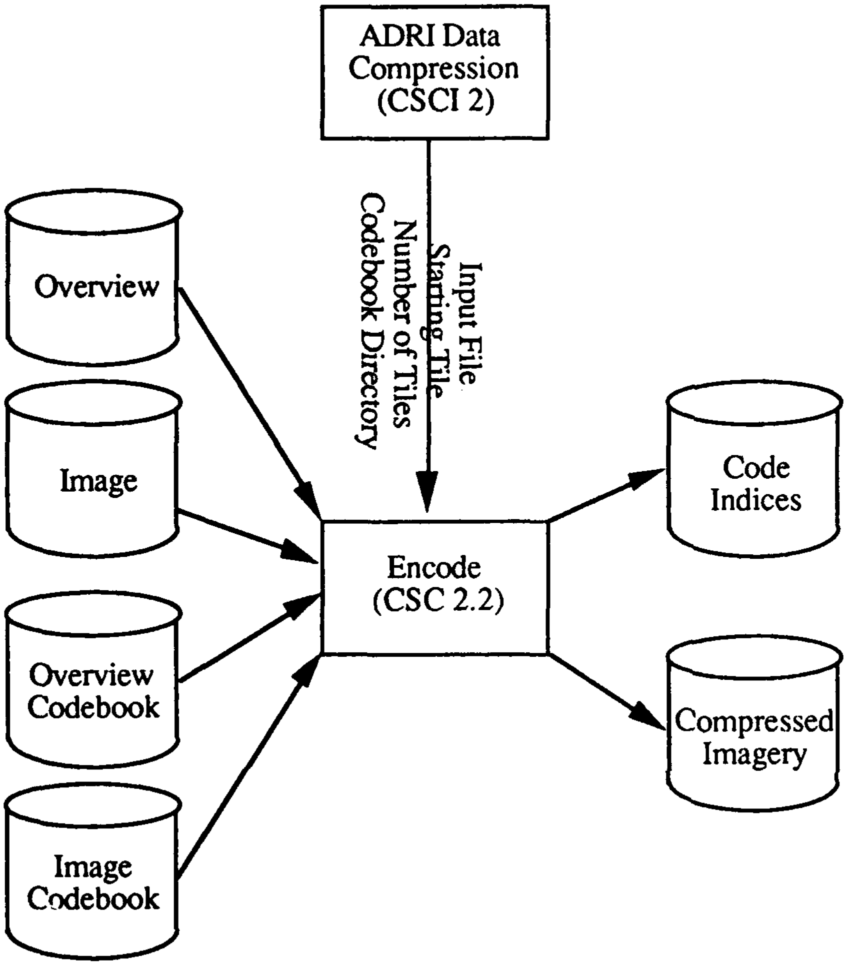


Manual Operation:

User specifies and inputs overview or image file, and optional parameters.

Train produces a codebook file for the overview or image file.

Exhibit A-13
Encode, CSC 2.2



Manual Operation:

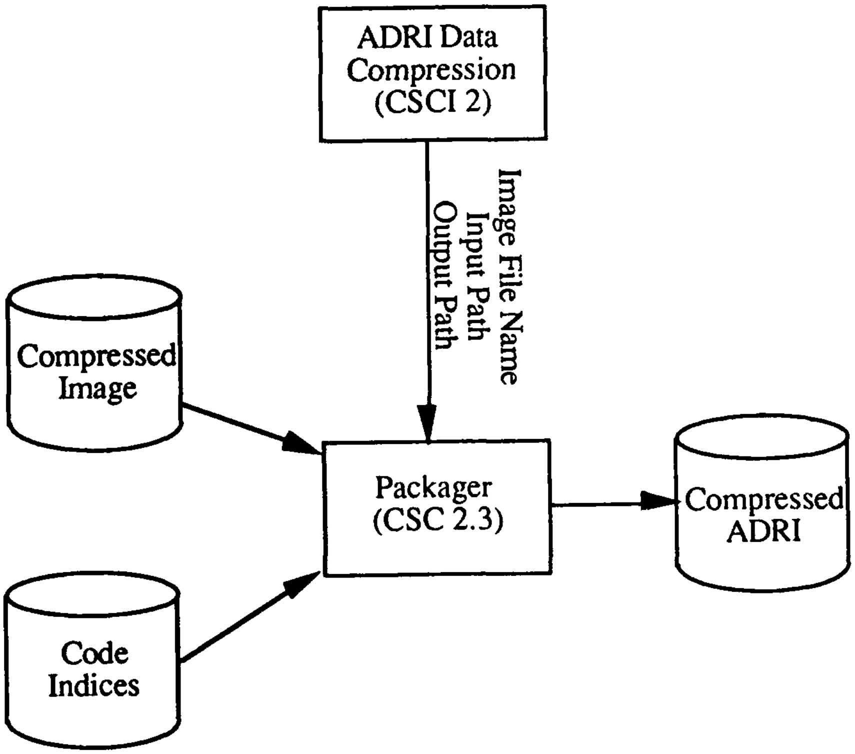
User specifies and inputs overview or image file, and optional parameters.

Encode retrieves corresponding codebook.

Encode performs arithmetic coding, lapped orthogonal transform, and vector quantization.

Encode outputs a compressed overview or image file, and an indices file.

Exhibit A-14
Packager, CSC 2.3

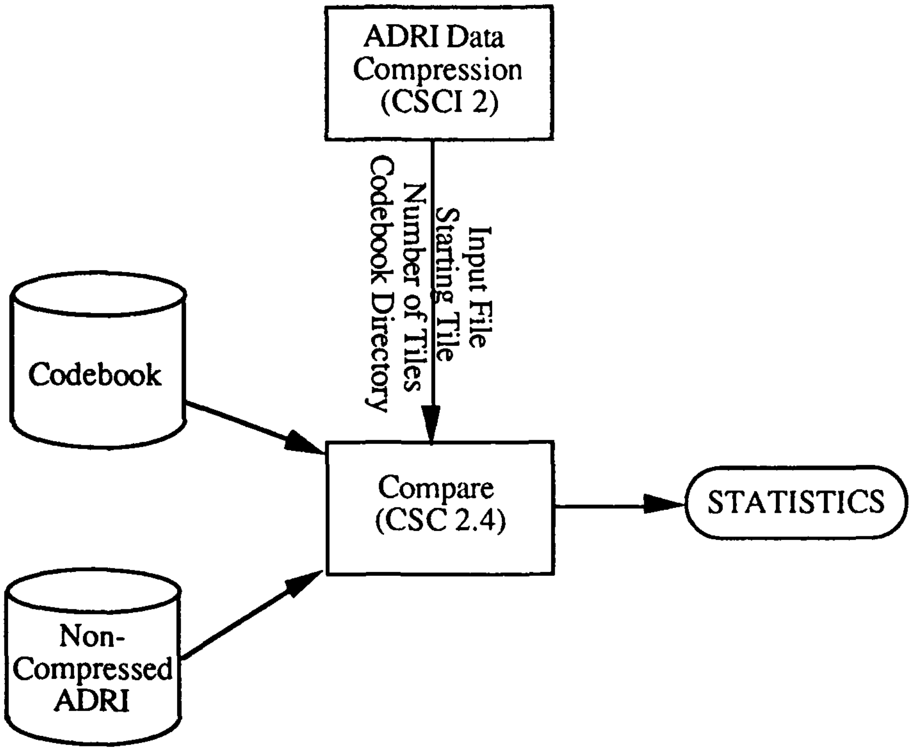


Manual Operation:

User specifies a compressed overview or image file, and its corresponding indices file.

Packager assembles the two files into a compressed ADRI file.

Exhibit A-15
Compare, CSC 2.4



Manual Operation:

User specifies input file (noncompressed imagery), and codebook name for compressed imagery.

Compare generates statistics indicating image quality before and after compression.

APPENDIX B

1.0 COMPRESSED ADRI FORMAT

CSCI 2 produces a compressed ADRI data set with a format very similar to the standard ADRI specification. This appendix describes this format.

1.1 DIFFERENCES BETWEEN COMPRESSED/NONCOMPRESSED ADRI

The compressed ADRI format is nearly identical to the standard ADRI format. The sections given below detail differences between the two formats. The text of the standard ADRI spec is given with changes to support compressed data highlighted in boldface.

Paragraph 3.9.3 of the compressed specification should read as follows:

3.9.3 External / descriptive file names

Descriptive Name	External Name
TRANSMITTAL_HEADER_FILE	TRANSH01.THF
TEST_PATCH_IMAGE_FILE	TESTPA01.CPH
GENERAL_INFORMATION_FILE	ssccdd01.GEN
QUALITY_FILE	ssccdd01.QAL
OVERVIEW_IMAGE_FILE	ssccdd01.**OVC**
GEO_DATA_FILE	ssccdd01.**IMC**

Paragraph 3.11.3-b of the compressed specification should read as follows:

b. Records and fields.

IMAGE_RECORD_(OVERVIEW)
RECORD_ID_FIELD (tag 001)
PADDING_FIELD (tag PAD)
CODE_BOOK_FIELD (tag CDB)
DATA_INDEX_FIELD (tag CDX)
PIXEL_FIELD (tag SCN)

Paragraph 3.11.4-b of the compressed specification should read as follows:

b. Records and fields.

IMAGE_RECORD_(ZDR)

RECORD_ID_FIELD (tag 001)
PADDING_FIELD (tag PAD)
CODE_BOOK_FIELD (tag CDB)
DATA_INDEX_FIELD (tag CDX)
PIXEL_FIELD (tag SCN)

Paragraph 3.14.3 of the compressed specification should read as follows:

3.14.3 OVERVIEW IMAGE FILE.

IMAGE_RECORD_(OVERVIEW)

IMAGE_ID_FIELD (tag 001)

RTY	A	3	IMG	Record type
RID	A	2	01	Record ID number

PADDING_FIELD (tag PAD)

PAD	A	Var	SP	Padding so that the image pixels start at the beginning of a 512 byte boundary

CODE_BOOK_FIELD (tag CDB)

***CBK**	**A**	**1**		**4096 8-bit code book values**

DATA_INDEX_FIELD (tag CDX)

***IDX**	**A**	**32**	**Indices into the SCN field to locate beginning of each tile**

PIXEL_FIELD (tag SCN)

*PIX	A	1		Pixel value (unsigned 8-bit binary integer)

Paragraph 3.14.4 of the compressed specification should read as follows:

3.14.4 GEO DATA FILE.

IMAGE_RECORD_(ZDR)

IMAGE_ID_FIELD (tag 001)

RTY	A	3	IMG	Record type
RID	A	2	01	Record ID number

PADDING_FIELD (tag PAD)				
PAD	A	Var	SP	Padding so that the image pixels start at the beginning of a 512 byte boundary
CODE_BOOK_FIELD (tag CDB)				
***CBK**	**A**	**1**		**4096 8-bit code book values**
DATA_INDEX_FIELD (tag CDX)				
***IDX**	**A**	**32**		**Indices into the SCN field to locate beginning of each tile**
PIXEL_FIELD (tag SCN)				
*PIX	A	1		Pixel value (unsigned 8-bit binary integer)

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